Woroschiloff upon the paths of conduction in the spinal cord, for example), are confined to small print. Exception might also be taken to the somewhat dogmatic decision of an undecided question, such as that of the cause of the pulse-dicrotism. And it may be doubted whether the introduction, if not of pictures, at least of a greater number of diagrams, would not render some of the subjects easier to the comprehension of the student. But looked at as a whole, the book must be pronounced thoroughly well done, admirably adapted for its purpose, and creditable alike to its author and to the science which it is intended to promote.   E. A. SCHÄFER

WEISBACH'S "MECHANICS OF ENGINEERING"

A Manual of the Mechanics of Engineering, and of the Construction of Machines, with an Introduction to the Calculus, by Julius Weisbach, Ph.D. Vol. I.—Theoretical Mechanics. Translated from the Fourth Augmented and Improved German Edition, by Eckley B. Coxe, A.M. (London: Trübner and Co., 1877.)

THERE is, perhaps, no book on mechanics so well suited to the wants of civil and mechanical engineers as the late Dr. Weisbach's "Lehrbuch der Ingenieur und Maschinen-Mechanik." In his preface to the first edition of his work the author thus stated his design (we quote from the translation before us) :—

"My principal effort has been to obtain the greatest simplicity in enunciation and demonstration, and to treat all the important laws in their practical applications without the aid of the higher mathematics. If we consider how many subjects a technical man must master in order to accomplish anything very important in his profession, we must make it our business as teachers and authors for technical men to facilitate the thorough study of science by simplicity of diction, by removing whatever may be necessary, and by employing the best known and most practicable methods. For this reason I have entirely avoided the use of the calculus in this work. Although at the present time the opportunities for acquiring a knowledge of it are no longer rare, yet it is an undeniable fact that unless we are constantly making use of it, we soon lose that facility of calculation which is indispensable ; for this reason so many able engineers can no longer employ the calculus which they learned in their youth. As I do not agree with these authors who in popular treatises enunciate without proof the more difficult laws, I have preferred to deduce or demonstrate them in an elementary, although somewhat in a roundabout manner."

Weisbach was severely censured by some people for attempting to treat his subject without the higher mathematics, but he kept to his own way, saying that he intended his work not as a university text-book, but only for "practical men." In the later editions of his work, however, he gave additional demonstrations of some of the laws by the differential and integral calculus, on which he also added an introductory chapter, which surpasses in clearness anything we have seen on the subject. In judging of Weisbach's method we must not forget that few men had so much experience in teaching practical engineers, and that no one had a better knowledge of what such men really require ; and we must at least acknowledge that, although in some few cases he may have carried his system too far, and have sacrificed scientific exactness of expression to mathematical simplicity, if he erred, he did so on the right side. Most English

authors of books on mechanics and kindred subjects seem to forget how small is the amount of mathematical knowledge possessed by the average engineer. In the rising generation of engineers this is no doubt changing for the better, but there are still many in this country—men of ability and men who have executed works which do credit to the nation—whose ideas of the differential and integral calculus are vague in the extreme, and it is satisfactory that there is at last a standard work for their use.

The work appeared originally in two parts. The first "Theoretische Mechanik," and the second, "Statik der Bauwerke und Mechanik der Umtriebsmaschinen." To these was afterwards added a third, "Mechanik der Zwischen und Arbeits-Maschinen." The volume before us is a reprint of an American translation of the fourth German edition of the "Theoretische Mechanik." This edition was published in 1863. In 1875, after the author's death, a fifth edition was issued, which differs to a small extent from the fourth. It contains a chapter on springs, taken principally from Reuleaux's "Construction und Berechnung der für den Maschinenbau wichtigsten Federarten ;" another on the general principles of dynamics, also, in the Appendix, "The Elements of Graphical Statics," none of which are in the fourth edition. We regret that the chapter on graphical statics was not added to the translation. The graphical method seems likely to come more generally into use, and a short introduction to it, giving the general rules for its application to statics, and showing the manner of using it, would have added to the value of the book.

Mr. Coxe has done the work of translation carefully, and, on the whole, well. He has avoided the blunders made by the author of the former translation, and he has given a faithful rendering of the German. He uses, however, many terms which are not in use in this country, and we are sorry that they are far from being improvements. He talks, for example, of the centre of gravity of lines and geometrical figures, of "living forces" (surely *vis viva* was quite bad enough), &c. There is room for difference of opinion as to whether Mr. Coxe has done wisely in retaining the various tables in the book on the metric system.

This translation is wonderfully free from misprints, and most of those which do exist are quite apparent. On p. 479, for example, we find the following :—"REMARK.— Under the supposition that the proof strength increases and decreases with the ultimate strength, the English engineers increase the size of that portion of cast-iron girders which is subject to *compression*," &c. (the italics are ours). On p. 121, § 21, $v = \frac{\sigma}{\tau}\left(\frac{ds}{dt}\right)$ should be :

$v = \frac{\sigma}{\tau} = \frac{ds}{dt}$, and "The element of time τ (dt)" should be : The element of time $\tau = dt$. On p. 291, § 157, we have : "From this we obtain $QR = \overline{OR}.\tan.\phi = \overline{OR}$." Then on the line below " $\frac{y}{b} . \frac{V}{H}$, which is the difference,"

&c. This should be $QR = OR.\tan.\phi = OR.\frac{y}{b} . \frac{V}{H}$.

Weisbach's name is known in this country principally in connection with hydraulics. In this branch of mechanics he was a most laborious experimentalist, and he obtained many valuable results, many of which are incor-

porated in the work before us. In this first volume of his work the discharge of water is very fully treated. Unfortunately, however, his so-called theoretical formulas belong to the same category as those which Prof. James Thomson of Glasgow showed in his paper, read before the last meeting of the British Association, to be founded on assumptions which are not in accordance with known hydrodynamic principles.

On page 851 of this translation there is a formula to which we would draw attention. It is taken from "The Lowell Hydraulic Experiments," by J. B. Francis, and is for the discharge of water over a weir. This formula is "$Q = 3\cdot33\ (l - 0\cdot1\ nh)h^{\frac{3}{2}}$ English cubic feet, in which h denotes the head of water above the sill of the weir, l its length, and n either 0 or 1 or 2, according as the contraction of the vein is prevented upon both, one, or none of the sides." Prof. Thomson, in the above-mentioned paper, referred to this formula as identical, in its general form $a\ (l - \beta n h)h^{\frac{3}{2}}$, with the one which he had deduced from known principles as the true theoretical formula. Mr. Francis put it forward merely as an empirical formula which agreed with the results of his experiments, and it is curious that he should have made a guess which turned out to be more in accordance with the true theory, than all the previous so-called theoretical formulas, which had been advanced and sanctioned by the best authorities.

PATRICK EDWARD DOVE

OUR BOOK SHELF

A General Dictionary of Geography, Descriptive, Physical, Statistical, Historical; forming a Complete Gazetteer of the World. By A. Keith Johnston, F.R.S.E. New edition, thoroughly revised. (London : Longmans and Co., 1877.)

THE title of this work is somewhat misleading. The "physical" and "historical" elements are so meagre that they are scarcely worth mentioning as features of the work. To call this a *"complete* gazetteer of the world"* is a misuse of the term "complete ;" *incomplete* would have been more accurate. Even on the scale of the present work it would take a gazetteer at least three times its size to contain anything like a register of all the places one would naturally expect to find in a "complete" gazetteer. The work includes a selection of the more important places in the world, very few towns, for example, out of the United Kingdom being given, whose population is under 1,000. We find no fault with the publication of a selective gazetteer, but it should not pretend to be more than it is. When compared with Ritter's well-known work, *e.g.*, the proportion of places found in the latter as compared with "Johnston" is something like five to one. We believe a service would be done to the public by the issue of a gazetteer containing simply all the names omitted in "Johnston." It is not for well-known places we turn up a gazetteer, but for names that one seldom hears. During these Eastern troubles, how many names of places not to be found in "Johnston" have become of great importance, and during the war just begun how many more are likely to come prominently into notice? On the other hand, much valuable space is occupied with catalogues of streets and public buildings in the articles devoted to well-known places like London, Edinburgh, Paris, Vienna, &c. All that can be said about public buildings and similar features of a town in a gazetteer of this scale is practically useless ; the space would be used to much better purpose by an enlargement of the list of names. In Russia, for example, nearly all "towns" and "villages" seem to be omitted.

many of them with thousands of inhabitants, only "district towns," as a rule, being given. Poland and Finland are also very unsatisfactory ; in fact these countries have never been properly "gazetteered" even in Russia. In several instances the "latest" information has evidently not been obtained. To get it, indeed, would involve a vast amount of research among official publications and travellers' narratives, but in a standard work such research is demanded. In Switzerland, we are informed by a Swiss friend, much of the information is half a century behind date. Under Chaux-de-Fonds, *e.g.*, the statement with regard to the manufacture of chains for the movements of watches has not been true for at least thirty years ; and there is no lace now made at St. Imier. To arrange the wealth of information published by the United States Survey alone would involve much time and labour ; we fear that for the new edition this has not been thoroughly done. Nearly two years ago Mr. W. H. Dall, of the United States Coast Survey, published a Report on the mountains in the Alaska territory. Yet no use has been made of this Report though it is quite accessible. For Mount St. Elias the height in the English Admiralty Chart, 14,970 feet is given, instead of upwards of 19,000 feet, obtained by the careful measurement of the United States Survey in 1874. The height of Mount Fairweather is set down as 14,708 (1855) instead of 15,500 (1874) ; Mount Crillon 13,500 instead of 15,900 ; Mount Cook 16,000, Mount La Perouse 11,300, and Mount Vancouver 13,100 feet, are not given. Such imperfections make one doubt if this new edition has been "thoroughly revised." It is easy to give information contained in census tables and in other gazetteers and guide-books, but even a work on the limited scale of the present cannot be made throughout trustworthy without very considerable trouble being taken.

Zoological Classification. By F. C. Pascoe, F.L.S. (John Van Voorst, 1877.)

THIS small work will be found particularly serviceable to many working naturalists. It is a concise compilation of the sub-kingdoms, classes, and orders of the animal kingdom, with lists of the families and most important genera. Specialists will be able to find fault with some of the details in many cases, nevertheless we know no volume which, in the space, contains so much reliable information. The larger groups are all succinctly defined, with many of the most modern views incorporated ; and these definitions extend to the orders. Taking the mammalia for criticism, we regret to find the Sirenia included with the Cetacea, the Musk Deer with the Chevrotains, the Peccaries with the true Swine, and the Camels between the Giraffe and the other typical ruminating animals. The caccum is not "enormous" in Hyrax. "Whatever gaps there may be at the present day" between the Perrissodactyla and Artiodactyla "are *not* nearly all filled in by numerous extinct forms." Such errors may be found in many places ; they do not, however, much detract from the general value of the work, which will be found more valuable as a basis for annotation, than a book of reference. There is a very complete index we are glad to say.

Tracts relating to the Modern Higher Mathematics. Tract No. 2, Trilinear Coordinates. By Rev. W. Wright, Ph.D. 77 pp. (London : Messrs. C. F. Hodgson and Son, 1877.)

DR. WRIGHT is, or was until quite recently, Professor of Mathematics at Wilson College, Pennsylvania. His object is to make his countrymen acquainted with certain branches of modern mathematics, and we learn that his first venture (Tract No. 1, *Determinants*) has met with considerable acceptance in the American universities. M. Hermite, too, has expressed himself well pleased with the author's standpoint, " Une grande transformation s'est déjá faite et continue encore de se faire dans le domaine de l'analyse ; des voies nouvelles plus fécondes, et